MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

DET5058 – DIGITAL ELECTRONICS

(Diploma in Electronic Engineering)

14 OCTOBER 2019
2.30 p.m. – 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **5** pages (excluding the cover page and appendix).
2. Answer **ALL** questions. All necessary working steps must be shown.
3. Rules of Boolean algebra is provided in the Appendix section.
4. Write all your answers in the answer booklet provided.

QUESTION 1 [25 Marks]

a) Convert $1B4E_{16}$ to:

(i) Binary

[2 marks]

(ii) Decimal

[2 marks]

(iii) Octal

[2 marks]

(iv) BCD

[2 marks]

(v) Gray code

[2 marks]

b) Given two decimal numbers, + 99 and – 47, multiply the numbers in 2's complement form. Show that your final answer is equivalent to – 4653 by converting the final answer into decimal.

[15 marks]

Continued...

QUESTION 2 [25 Marks]

a) Given a Boolean expression $X = \overline{AB\overline{C} \cdot \overline{C}D}$, answer the following:

(i) Draw the logic circuit of the Boolean expression.

[4 marks]

(ii) Construct the truth table for the Boolean expression.

[4 marks]

(iii) Simplify the Boolean expression using the rules of Boolean algebra.

[3 marks]

(iv) Draw the logic circuit of the simplified Boolean expression using NOR gates only.

[5 marks]

b) Given a Boolean expression $W = \overline{P}Q + P\overline{RS} + \overline{Q}R + \overline{P}Q\overline{RS}$, answer the following:

(i) Produce the standard Sum-of-Product (SOP) expression for W.

[6 marks]

(ii) Write the equivalent standard Product-of-Sum (POS) function for W.

[3 marks]

Continued...

QUESTION 3 [25 Marks]

Figure 1 shows a timing diagram, where P, Q, R and S are the inputs of a system and X is the respective output. Based on the diagram, answer the following questions.

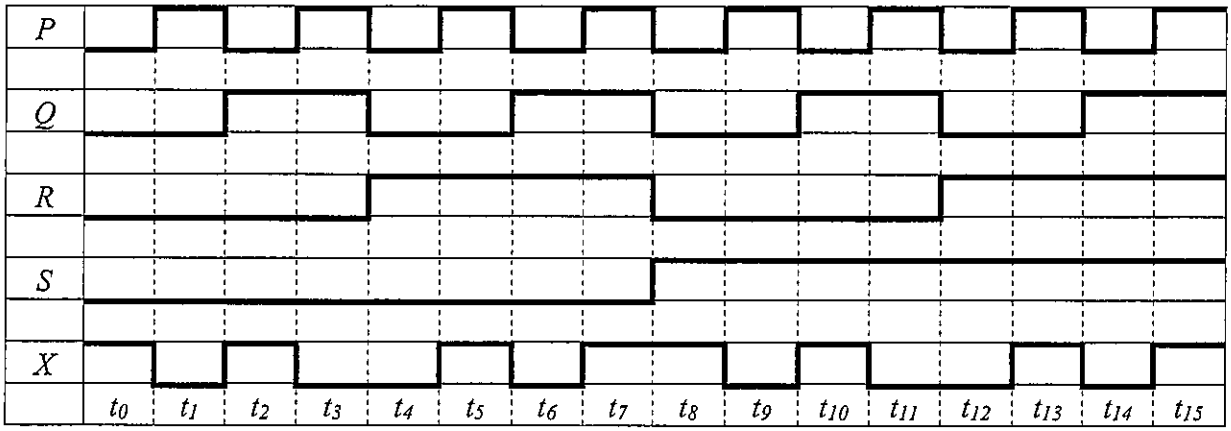

Figure 1

a) Construct the truth table of the system.

[4 marks]

b) Based on your answer in (a), draw the AND-OR network of the system.

[6 marks]

c) Using two separate Karnaugh maps, provide the minimized SOP and POS expression of the system.

[9 marks]

d) If the output for inputs 0001 and 1001 is replaced by a 'don't care', state whether the don't care terms could help to further simplify the system. Explain your answer with the aid of a Karnaugh map.

[6 marks]

Continued...

QUESTION 4 [25 Marks]

a) Design a logic circuit to convert 4-bit binary into Gray code. Label the binary input as B_n, and the Gray code output as G_n, where $n = 0, 1, 2, 3$.

[5 marks]

b) Figure 2 shows the logic symbol of a full subtractor. A and B are the binary inputs, B_{in} is the borrow-in bit and B_{out} is the borrow-out bit.

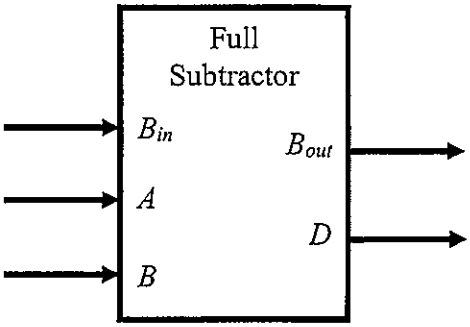

Figure 2

Provide the truth table for the full subtractor.

[8 marks]

c) Referring to the diagram in Figure 3, answer the following questions.

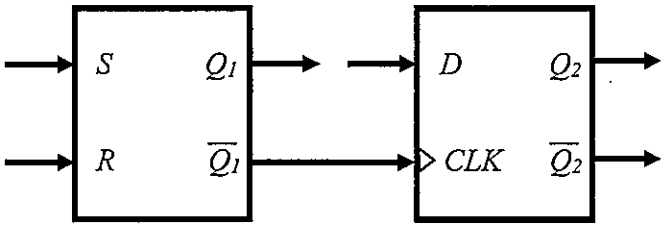

Figure 3

(i) Name the two logic symbols present in Figure 3.

[4 marks]

(ii) Draw the output waveforms of $Q_1, \overline{Q_1}, Q_2$ and $\overline{Q_2}$ based on the given input waveforms in Figure 4 (refer to page 5). Assume both named logic symbols in (i) are initially LOW.

[8 marks]

Continued...

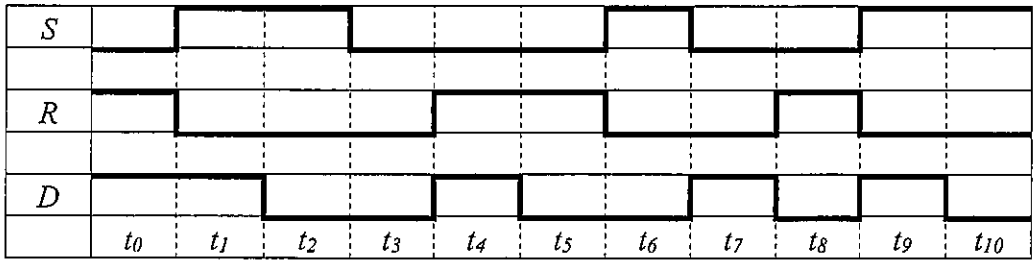

Figure 4

End of Page

APPENDIX: RULES OF BOOLEAN ALGEBRA

1. $A + 0 = A$
2. $A + 1 = 1$
3. $A \cdot 0 = 0$
4. $A \cdot 1 = A$
5. $A + A = A$
6. $A + \overline{A} = 1$
7. $A \cdot A = A$
8. $A \cdot \overline{A} = 0$
9. $\overline{\overline{A}} = A$
10. $A + AB = A$
11. $A + \overline{A}B = A + B$
12. $(A + B)(A + C) = A + BC$